Modeling and Simulation of a Vertical Wind Power Plant in Dymola/Modelica

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A small wind power plant connected to the grid has been modeled in Modelica/Dymola and controlled using external controllers written in C++. The small wind power plant consists of three wind power units, with a nominal power of 3kW, and one grid connection interconnected with an internal DC-grid. All the controls needed for controlling and optimizing the operation of the individual parts in the plant were developed and implemented. Apart from this a managing control for the entire plant were developed and implemented.

The control was implemented using an external static library interconnected with Dymola. the External Object approach for implementing objects in Modelica was also tested. The optimization algorithms developed for the wind turbine was done in a way so that no measurements of the wind speed are needed. The controls were developed so that they can achieve a number of different tasks such as Reactive Power Compensation and Island Control.

Models were implemented in Modelica using Dymola as tool. In order to model the power electronics involved in the system the Electric Power library (EPL) has been utilized. Models for the wind turbine were developed and tested.

The models were in the end tested and evaluated by running a number of different simulations. The Different test cases consists of optimizing the power output, controlling the power output to a desired level and island operation, that is to power up a small grid on its own.

Keywords: wind power, power electronics, control, optimization, vertical wind power, Electrical Power library

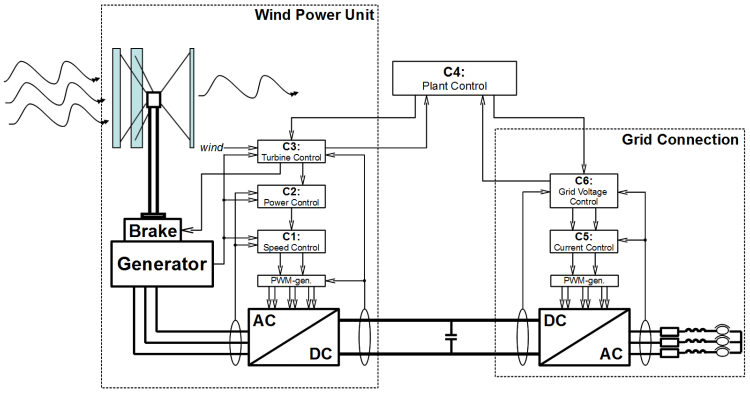

Figure 1: Overview of control structure and configuration of the wind power plant.